EFFECT OF ELECTROMAGNETIC FIELD ON SOME SELECTED CROP PLANTS

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By

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SYNOPSIS

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The flow of electricity along a wire / conductor establishing an electromagnetic field (EMF) around it influences the living organisms like plants, animals and human beings by the way of electromagnetic induction (*Markus Zhan, 1999)*

One of the sources of producing electromagnetic field is the high power transmission lines. Most of the areas in India are agricultural and forestlands, through which high power transmission lines pass. The voltage level of high power transmission lines are 400KV, 230KV, 110KV, etc., These electromagnetic field from high power transmission lines affect the growth of plants and human beings. However no reports are available on the effects of EMF from thee high voltage power transmission lines on the crop plants are essential / introduced.

A major contribution of the understanding of productivity has come through the application of plant growth analysis. ***Muthuchelian et al.,1988*** reported that leaf area was often used as indicator of plant species and for evaluating net assimilation and transpiration in relation to solar energy fixation. Several crop species showed a relationship between the leaf area productivity.

Therefore effect of EMF from high-power transmission lines (230 KV,110 KV) on the growth, physiological and biochemical characteristics of some selected crop plants are essential.The growth characteristics like shoot length, root length, leaf area. Specific leaf weight, total biomass content, total water content etc., some biochemical characteristics like chlorophyll, carotenoide, soluble sugar, soluble starch and soluble protein content of the plants under EMF from 230 KV,110 KV power line over the control plants are necessary and introduced.

The main objectives of the present study are,

- To measure the diurnal variation of electro magnetic field from 230 KV,110 KV power transmission lines for every one hour at various points vertically below the 230kv&110kv power lines, at various points at the ground along horizontally but normal to the power transmission lines and develop a model of flux by means of a Gauss meter.
- To measure the diurnal variation of current in the high power transmission lines (230 KV, 110 KV) using ammeter for everyone hour and electric field strength from 230 KV, 110 KV power lines.
- To find out the sensitivity, resistive nature , growth , difference in the productivity, survival rate , biomass production of the selected crop plants which are cultivated under 230 KV &110 KV power lines.

- To verify the effect of electromagnetic field from a EMF producing instrument (designed in the laboratory) on physiological and biochemical characteristics of some selected crop plants under the laboratory condition.
- To find out the effect of EMF on physiological characteristics of selected crop plants which are cultivated by the farmers in their agricultural lands under the high power transmission lines at the harvesting stage- under farm cultivation.
- To find out the effect of EMF from high power transmission lines on herbaceous species composition and forest biodiversity.

Experiments were performed and measured the variation of EMF from 230 KV,110KV power lines at various points vertically below the 230 KV,110 KV power lines and at various points at the ground along horizontally but normal to the power transmission lines. From our experiments gives the experimental evidence for Biot-Savert law of electromagnetism for a current carrying conductor..

From our study the diurnal variation of EMF (vertical and horizontal variation) from 110 KV and 230 KV power lines were gradually increases with time, some time it decreases and then increases to maximum value and there after it starts to fall down to a lowest field or a constant magnetic field. Again the magnetic field, it evinces with little fluctuations till the next day morning. This variation of EMF from 110 KV and 230 KV power lines were quite similar to the day, monthly and annually.

Hence the effect of EMF upon the growth of the plants under and in the proximity of the power transmission lines remains unaltered throughout the year. So for normal life the living system must be kept well away from the high power transmission lines. Regarding the line of transmission. The strength of the EMF established by 230 KV power lines was stronger than that of 110 KV power lines.

The electric field strength in 110 KV and 230 KV power transmission lines were also calculated. The calculated value of electric field strength in 110 KV was 211 KV/m and in 230 KV was 442 KV/m.

According to the Biot-sarvert law of electro-magnetism for a current carrying conductor, the intensity of the magnetic field is directly proportional to the current flowing through the conductor. Therefore the diurnal variation of current (for every one hour) in the experimental power lines (110 KV and 230 KV) were also observed and recorded.

From the observation of diurnal variation of current in 110 KV and 230 KV power transmission lines, current in amperes gradually increases or decreases and reaches to maximum current or minimum current and thereafter it starts to fall down to lowest current or raises to maximum current or a constant current. Again the current, it evinces with little fluctuations till the next day morning. This variation of current in the power lines was due to the variations of load. ie., it depending upon the amount of electricity consumed by the consumers.

Hence the effect of EMF (due to current flowing in the power lines) upon the growth of plants under the high power transmission lines remains unaltered throughout the year.

Experiments were performed to find out the effects of EMF on growth physiological & Bio chemical characteristics of some selected crop plants viz, *Vigna mungo(*black gram*)* *Zea mays*,(maize) ,*Vigna unguiculata*(cow pea) *and Oryza sativa* (rice) respectively in four phases.

In the first phase of the experiment, the above said four experimental crop plants were shown in earthen pot's filled with garden soil (p^H 6.9) grown separately.

i) Under and in the proximity of 110 KV and 230 KV power transmission lines were taken as EMF stressed plants.

ii) A similar set of above said four experimental crop plants were grown separately well away (300m) from the high power transmission line were taken as control plants.

It was noted that how the growth, physiological and bio chemical mechanism triggered on the four crop plants which were grown under the 110 KV and 230 KV power lines for a period of 20 days. From this study it was found that the response of the crop to EMF from 110 KV and 230 KV Power lines showed variations among themselves. Based on the results the growth characteristics like shoot length, root length, leaf area, leaf fresh weight, specific leaf weight, shoot/root ratio, total biomass content and total water content of the four crop plants were reduced significantly over the control plants. Similar trend were observed in the biochemical characteristics like chlorophyll - a, chlorophyll - b, total chlorophyll, content, carotenoid content, soluble sugar, soluble starch and soluble protein content of the plants grown under 110 KV and 230 KV power lines. However the magnitude of reduction in growth, physiological and bio-chemical parameter of the crop plants under the proximity of the 230 KV power lines was higher than 110 KV power lines.

Reduced growth and physiological parameter was primarily due to the effect of reduced cell division and cell enlargement. Further the growth was stunted which may be due to poor action of hormones responsible for cell division and cell enlargement.

The bio-chemical changes produced in this plants due to EMF stress quite obvious and it affects the production leading to economic loss.

In the second phase of the experiment, the growth, physiological and biochemical characteristics due to the EMF stress was conducted and verified by means of growing

the same selected four crop plants under continuous EMF of 956 mG(milli Gauss) in the laboratory conditions. For this study a continuous electro magnetic field producing instrument was also designed and fabricated in our laboratory.

The selected four crop plants were grown in plastic cups filled with the same garden soil under continuous EMF of 956 on G in our laboratory. A similar set of crop plants were grown in the laboratory without magnetic field as control plants. The temperature, intensity of light and relative humidity were same for both EMF stressed plants and control plants.

It was also noted that how the growth physiological and biochemical mechanism triggered on the crop plants, which were grown under the continuous magnetic field of 956 mG for a period of 12 days. During this study the response of the crop to EMF (956 mg) also showed variations among themselves. Based on the results the growth, Physiological and biochemical characteristics of the crop plants were also significantly reduced similar to the plants grown under 110 KV & 230 KV power lines.

From this laboratory experiment it is evident that the EMF primarily affects the physiological and biochemical components and thereby reduces the productivity.

In the third phase of the experiment the effect of EMF from high power transmission lines on the yields of agricultural crop plants cultivated by the farmers in their agricultural lands which is under the high power transmission lines was studied.

The experiment was carried out after the development of vegetation or nearing the harvesting stage, the physiological maturity plants grown under the proximity of the higher power transmission lines and the plants in the control sites (without power lines) were randomly harvested and analyzed. The response of the crops under high power

transmission lines also showed variations among themselves and the growth parameter were significantly reduced.

Growth characteristics such as shoot and root lengths, leaf area, specific leaf weight, biomass, shoot/root ratio, sturdiness quotient and shoot diameter of the crop plants were reduced considerably in all the three plants of experimental studies.

(I) Under EMF from 110 & 230 KV power lines, Pot culture.

(II) Under EMF (956 mG) in Laboratory condition

(III) Under EMF from 230 KV power line in farm cultivation

Chlorophyll a, Chlorophyll b, total Chlorophyll contents and carotenoid contents of the four crop species were significantly reduced under EMF from 110 KV & 230 KV powers lines. The same result was observed under continuous magnetic field (956 mG) in laboratory condition also.

A significant reduction in leaf soluble starch, leaf soluble sugar and leaf protein contents was observed under EMF from high power transmission lines (110 KV & 230 KV) and continuous magnetic field (EMF 956 mG) in laboratory condition.

So from the above three phases of experiment we come to conclude that the reduced growth parameter shown in the crop plants would indicates that the EMF has exerted a stress on that plants and this EMF stress was quit obvious and it affects the production leading to economic loss. So further research activities are needed to safe guard plants from EMF stress.

In the fourth phases of the experiment the status and distribution of plant communities and its composition due to the passage of high voltage power transmission lines through the forestlands of Ayyanar koil hills of Western ghats were studied. From

our study it was observed that the number of herbaceous species was greater in the site II natural forest area compared to the site I area which is under the high power transmission lines. Taxonomically, the numbers of families were more in site II (natural forest) compared to site I (under the high power transmission line). Herb diversity indices were also lesser in site I (under the high power transmission lines) compared to the site II (natural forest). So further studies are needed to safe guard the plants from EMF stress from high power transmission lines and real pattern of regeneration and dynamic changes due to the effect of EMF from high power transmission lines. Hence for better ecological status, conservation of the forest species are suggested.